

specifically refers to Ultrasil (column 4, example 4). The examiner acknowledges that this patent does not provide the agent in the osmotic solution. However, he has suggested that a person of ordinary skill in this art would be able to predict the improvement in membrane cleaning by providing the agent (antifouling) within the concentrate solution.

The applicants respectfully submit that the examiner has misunderstood the teachings of Herron et al. and has therefore incorrectly concluded that it would be obvious to arrive at the present invention. Herron et al. do not suggest that fouling occurs in the osmotic agent (equivalent to the second solution in the present invention). Instead, Herron et al. teach that fouling occurs in the first solution (see below).

Herron et al. teach that concentrating products containing large organic molecules and solutions with suspended solids (e.g. pulp from orange juice) creates severe membrane fouling problems. Even if the product is filtered first to remove suspended solids, there is severe fouling due to deposition of films on the surfaces of the semipermeable membrane (see column 2, lines 39 to 45). In the terminology of the present invention, the product to be concentrated in Herron et al. is equivalent to the first solution of the present invention. Herron et al. go on to teach that one way to overcome this problem is to induce a high degree of turbulence at the membrane surface to sweep molecules away from the membrane surface before they adhere due to stronger bond formation (see column 2, lines 53 to 56).

Another way to overcome the fouling problem is outlined in Example

4. Example 4 of Herron et al. illustrates the concentration of coffee as a step in the production of instant coffee or liquid coffee concentrates.

Successive coffee batches are concentrated from 5 Brix to between 56 to 63 Brix using 60-70 Brix HFCS (high fructose corn syrup- 55% fructose, 42% glucose, 3% sucrose) as an OA (osmotic agent). Thus, it is clear that the osmotic agent is the sugar solution (the "second solution" using the terminology of the present invention). The coffee solution to be concentrated is the "first solution." The Example goes on to describe that the membranes are cleaned every 8 to 10 hours of use by flushing with water for 5 to 15 minutes. After this flushing no coffee deposits were visible inside the cell. The cell is cleaned between batches with a 5 minute recirculation with ULTRASIL cleaner followed by a water rinse. The only fouling that is taught or suggested in this document is fouling of the membrane and cell by the coffee. There is no suggestion of any fouling of the cell or the membrane on the side of the second solution (i.e., on the osmotic agent side).

In the present invention the first solution comprises seawater, which is typically a substantially impure solution, while the second solution may be formed as a substantially clean second solution by dissolving a selected solute(s) in a selected solvent. To carry out the present invention, the first solution (e.g., seawater) is contacted with one side of a membrane under direct osmosis conditions. The second solution

is then contacted with the opposite side of the membrane. Since the first solution contains a significant proportion of contaminants, a person of ordinary skill might expect fouling to occur on the first solution-side of the membrane. This is analogous to the situation shown in Example 4 of Herron et al. outlined above where fouling by the coffee (first solution) on the membrane is observed. In Example 4 of Herron et al. this problem is solved by stopping the osmotic process and cleaning the apparatus. Given the fouling occurring in the first solution, a person of ordinary skill might be inclined to add anti-fouling agents to the first solution. However, since the second solution is substantially clean, he would not expect this solution to cause any membrane fouling. Indeed, the fact that the present inventors have unexpectedly found that significant amounts of contaminants will flow across the first selective membrane from the first solution into the second solution is particularly surprising as the flow takes place against the concentration gradient. There is no suggestion of this occurring in any of the prior art documents.

The present inventors have solved this problem by putting an additive selected from anti-scaling agents, corrosion inhibitors, anti-fouling agents and disinfectants in the second solution.

It would not be obvious to arrive at this solution in the light of the prior art. The applicant acknowledges that additives selected from anti-scaling agents, corrosion inhibitors, anti-fouling agents and disinfectants are known per se. Indeed, as outlined above, a person of ordinary skill

may consider putting such additives in the first solution which is known to contain contaminants. However, there is no suggestion or teaching in the prior art that would lead a person of ordinary skill to consider putting them in the second solution. Indeed, why would he/she? Before the filing date of this application the problem of fouling of the second solution was not known, yet alone a solution considered.

As outlined above, Herron et al. teach that the problem of fouling may be either addressed by increasing the turbulence near the membrane, or by stopping the process and cleaning the apparatus before restarting. Thus, a person of ordinary skill in this art would have been taught away from arriving at the present invention. If this latter cleaning process was carried out in the present process, it would be costly in terms of the raw materials used. This is because the solvent and the solute species in the second solution would need to be replaced. It would also be costly in terms of the amount of time which would be wasted during which the process could not be run whilst the cleaning was being carried out.

In contrast to this, the present inventors have identified a previously undiagnosed problem, and have provided an elegant and non-obvious solution to the problem. The solution allows the process to be a continuous process for much longer than would be possible if contamination of the second solution occurred.

There is no motivation in the prior art documents to provide alternative methods for addressing problems of contamination of the system. Moreover, even if the person of ordinary skill did consider this problem with the knowledge that additives selected from anti-scaling agents, corrosion inhibitors, anti-fouling agents and disinfectants are known per se, there is nothing in any of the prior art documents to lead a person of ordinary skill to the present invention in which these additives are put in the second solution wherein the second solution is formed by dissolving selected solute species in water.

The examiner's prior art rejections based on WO 97/18166 in view of Lefebvre, Mickols and Herron et al. should be withdrawn.

The examiner has rejected claims 42-45 and 52-56 under 35 USC 103(a) as being unpatentable over Yaeli in view of Michols, Lefebvre and Herron et al. The examiner relies on Herron et al. as in the rejection discussed above. For the same reasons as discussed above, this reliance on Herron et al. is misplaced.


The examiner's prior art rejections should be withdrawn and the presented claims allowed.

Favorable reconsideration is requested.

Respectfully submitted,

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